Submitted to:
US EPA Region 8
Denver, CO

Submitted by:
Atlantic Richfield Company
La Palma, CA
July 3, 2012

Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility, and Flood Dike and Pond Embankment Improvements

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

Atlantic Richfield Company

Anthony R. Brown
Project Manager, Mining

4 Centerpointe Drive
La Palma, CA 90623-1066
Office: (714) 228-6770
Fax: (714) 228-6749
E-mail: Anthony.Brown@bp.com

July 3, 2012

VIA EMAIL AND HAND DELIVERY

Mr. Steven Way
On-Scene Coordinator
Emergency Response Program (8EPR-SA)
US EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Subject: Supplement to Field Sampling Plan
Rico-Argentine Mine Site – Rico Tunnels
Operable Unit OU01 Rico, Colorado

Dear Mr. Way,

A digital file in PDF format of the Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility, and Flood Dike and Pond Embankment Improvements, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado dated July 3, 2012 is being submitted to you today via email. Three (3) hard copies of the report will also be hand-delivered to your office on July 3.

Atlantic Richfield Company (AR) is submitting this report responsive to requirements in Tasks B, C, and F of the Remedial Action Work Plan accompanying the Unilateral Administrative Order for Removal Action, Rico-Argentine Site, Dolores County, Colorado, U.S. EPA Region 8, Docket No. CERCLA-08-2011-0005.

If you have any questions or comments, please feel free to contact me at (714) 228-6770 or via email at Anthony.Brown@bp.com.

Sincerely,

Anthony R. Brown

Tony Brown
Project Manager
Atlantic Richfield Company

Enclosure (Supplement to Field Sampling Plan for Solids Repository, Permanent Drying Facility, and Flood Dike and Pond Embankment Improvements)

cc: Terry Moore, Atlantic Richfield
Chris Sanchez, AECI
Sandy Riese, EnSci
Dave McCarthy, Copper Environmental
Tom Kreutz, AECOM
Doug Yadon, AECOM

Table of Contents

TABLES

FIGURES

Supplement to Field Sampling Plan

for

Solids Repository, Permanent Drying Facility, and Flood Dike and Pond Embankment Improvements

at

Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01 Rico, Colorado

July 3, 2012

1.0 Introduction

AECOM Technical Services, Inc. (AECOM), in cooperation with Anderson Engineering Company, Inc. (AECI) and on behalf of Atlantic Richfield Company (AR), has prepared this Supplement to Field Sampling Plan (FSP) for investigation activities in the vicinity of the St. Louis Ponds system. The work described in this supplement is required to fill identified data gaps related to siting and design of the various facilities that may be required to be constructed or enhanced as part of the overall water treatment system. These facilities include flood dike and pond embankment improvements, a treatment solids drying facility, and a long-term solids repository(ies).

The work includes: 1) completion of soil borings, test pits and geophysical surveys in the various areas proposed for drying of lime treatment solids and for disposal of solids in one or more on-site repositories, and to further characterize the structural integrity of the existing flood dike and pond embankments; 2) construction of monitoring wells for geotechnical purposes in selected soil borings; and 3) laboratory testing of selected samples acquired during the field investigation work. The work is to be performed in the area of the St Louis Ponds, north of Rico, Colorado within Dolores County at the Rico Tunnels Operable Unit OU01 of the Rico-Argentine Mine Site.

1.1 Purpose

The purpose of this Supplement to FSP is to present a scope of work for subsurface geotechnical investigation and laboratory testing of the existing and potential new facilities noted above. These activities are responsive to the requirements under Tasks B, C and F of the Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado (Work Plan) dated March 9, 2011 (EPA, 2011). The results of this investigation will be used in the siting, selection and design of alternative and/or supplemental sites for new facilities required as part of a lime precipitation water treatment system should this technology ultimately be selected to treat mine adit discharge from the St. Louis Tunnel, and evaluation of further upgrades, if required, for the existing flood dike and pond embankments. This includes evaluation of Pond 13 as a site for temporary and possibly permanent storage/drying of solids yet to be removed from Ponds 11, 12, 14 and 15 and possibly permanent storage of the solids from Pond 18 previously placed in the interim drying facility at the Ponds 16/17 area.

In parallel with the work required to support design and construction of a water treatment system, additional site activities are underway that may affect the selection of the final water treatment technology for the St. Louis Tunnel site. These efforts include the ongoing source control investigation and technology screening evaluation. While AR is prepared to complete the work required in this Supplement to the FSP, it is possible that selection of the appropriate treatment technology could affect dewatering and solids management requirements. This decision will be made through discussion with the EPA following the initial evaluations which are anticipated to be completed by Fall 2012 and follow-on studies into early 2013.

1.2 Organization

Section 1.0 of this Supplement to FSP presents the purpose and organization of the report. Section 2.0 outlines the project organization, roles and responsibilities. Refined engineering geologic mapping of the site and adjacent ground is discussed in Section 3.0. The geotechnical investigation plans for soil/rock borings and groundwater level monitoring wells, and protocols for sample handling and custody of samples are described in Section 4.0. Section 5.0 presents the investigation plan for geophysical profiling; the geotechnical investigation plan for test pits is described in Section 6.0. The laboratory testing plan for samples collected during the subsurface investigation program is outlined in Section 7.0. References are provided in Section 8.0.

2.0 Project Organization, Roles, and Responsibilities

The purpose of this section is to define the areas of responsibility and lines of authority for each organization and for the members of the FSP team to facilitate decision-making during completion of the work.

The project management organization is presented on Figure 1, with the responsibilities of team members described in the following sub-sections.

2.1 Regulatory/Permitting Agency

The U.S. Environmental Protection Agency (EPA) is responsible for overseeing AR's performance of work for consistency and compliance with the provisions of the Work Plan. EPA's currently designated On-Scene Coordinator (OSC) is Mr. Steve Way. The EPA or their oversight contractor will periodically be on site during investigation activities.

2.2 Facility Owner

AR has the responsibility for implementing the work described in this Supplement to FSP. AR will coordinate overall management and implementation of the St. Louis Ponds area investigation activities.

AR is responsible for complying with the Project Documents and has the authority to select and dismiss subcontractors for completion of the investigation. AR also has the authority to accept or reject plans and reports, recommendations of the Investigation Field Manager, and the materials and workmanship of the various Subcontractors who may work on the site.

2.2.1 Project Manager

Mr. Tony Brown has been selected as AR's Project Manager. Mr. Brown will be AR's key contact person for EPA during the work. The Project Manager will also:

- Approve and sign submittals and progress reports or authorize others to sign submittals and progress reports on his behalf.
- Certify that the investigation has been completed in accordance with the approved Supplement to FSP.
- Sign the Completion of Investigation Report in addition to the AECOM Certifying/Design Engineer.

2.3 Investigation Field Manager

Mr. Christopher Sanchez, Certified Safety Professional (CSP) (AECI) will serve as the Investigation Field Manager. The duties of the Investigation Field Manager include:

- Report to the Project Manager for AR and to the Certifying/Design Engineer.
- Identify and coordinate scheduling of drilling and test pit excavation subcontractors, and the geophysical survey team member from AECOM.
- Oversee on-site investigation activities, including soil boring and test pit sampling and logging and geophysical surveying.
- Chair on-site project meetings related to the investigation work.

2.4 Certifying/Design Engineer

Mr. Doug Yadon, PE (AECOM) will serve as the Certifying/Design Engineer. The Certifying/Design Engineer is responsible for preparation of the final report resulting from the investigation work. In addition, the Certifying/Design Engineer or his designee will be responsible for:

- Selection of the number and location of borings and test pits, the depth of investigation at borings, monitoring wells the location of geophysical surveys, and the potential depth and methods for coring in rock where encountered during the course of investigation.
- Periodic observation (personally or by his designated representative) of the investigation work to assure that the work is in agreement with the intent of the Supplement to FSP and the anticipated design requirements.
- Direction of reduction, interpretation and analysis of field and laboratory geotechnical data.
- Direction of the preparation of the laboratory testing program based on investigation results, and selection and oversight of the geotechnical laboratory.
- Inclusion of the supplemental field test results in an addendum to Part A of the 2011 Investigations, Analyses and Evaluations report (Atlantic Richfield Company, 2011).

- Participate in key technical discussions with EPA and the various subcontractors.

2.5 Health and Safety Officer

Mr. Christopher Sanchez, CSP (AECI) or his appointed designee will serve as the Health and Safety Officer (HSO). The HSO will ensure that all Health and Safety Plan (HASP) requirements are effectively employed and enforced during investigation activities completed on-site.

2.6 Subcontractors

The Drilling and Excavation Subcontractors for this Supplement to FSP will be identified and contracted by AECI with input and concurrence by AECOM and final authorization by AR. The Geotechnical Laboratories for this Supplement to FSP will be identified and contracted by AECOM and AECI, with final authorization by AR. Information regarding the task specific Subcontractors will be provided to EPA as those Subcontractors are selected. The Subcontractors will be responsible for supplying materials and labor to complete the investigation in reasonable conformity with the requirements of this Supplement to FSP. As such, each Subcontractor is responsible for quality control (QC) to ensure that the work meets the requirements of this Supplement to FSP.

Before performing work at the site, the Subcontractor(s) will ensure that all necessary EPA approvals, authorizations, and coordination for EPA oversight have been secured or arranged.

The Subcontractors will immediately notify their respective QC Officer of unanticipated conditions encountered during the investigation or other conditions that the Subcontractor believes could affect the ability of the investigation to meet the design objectives. The QC Officer shall in turn notify the Investigation Field Manager for any concurrence or direction to respond to the unanticipated condition(s). The Investigation Field Manager will receive input from the Certifying/Design Engineer in matters that will or could affect the integrity of the analyses or designs to be based on the results of the field investigation program.

2.7 Quality Control (QC) Officers

Each Subcontractor will designate a QC Officer. The QC Officer is responsible for:

- Performing observations and tests by verifying that:
    - Regular calibration of investigation equipment is properly conducted and recorded.
    - The investigation equipment, personnel and procedures do not change over time or that any changes do not adversely impact the investigation process.
    - The boring, test pit and geophysical sampling/surveying and test data are accurately recorded and maintained.
- Identifying deficient work items and recommending corrective actions.
- Ensuring that agreed-upon corrective actions have been conducted and are sufficient to correct the deficiency.

Planned and actual locations for boring, test pit, monitoring well, and geophysical survey locations will be surveyed by AECI in an accurate and timely manner.

3.0 Engineering Geologic Mapping

A preliminary engineering geologic map has been prepared based on field mapping in 2011 and published geologic maps (see Figure 2). The objective of the mapping planned under this task is to update the preliminary geologic mapping and accompanying cross-sections for the purpose of developing an engineering geologic model of the site. This model will be further updated and refined based on the results of the other field investigations described later in the TM.

Available aerial photography and other remote imagery of the site and adjacent ground have been compiled and photo-interpretation currently in progress will be completed prior to mobilizing back to the field in 2012. The photo-interpretation includes identifying and mapping evidence of surficial and bedrock unit contacts, prominent jointing, faults or fault zones, areas of seepage, and slope instability (landslides, rockfalls, debris slides, etc.). Mining related features are also being identified and mapped, including existing and closed adit/tunnel portals and shafts and waste rock piles. Preliminary field engineering geologic mapping of the site and adjacent CHC Hill will be refined based on the ongoing photointerpretation and additional field mapping during the summer of 2012.

4.0 Geotechnical Investigation – Drilling, Sampling and In Situ Testing Program

4.1 Background

Substantial subsurface investigation and reconnaissance geologic mapping have been performed at the St. Louis Ponds site over at least the past 30 years, including a major program of investigations completed in 2011 (Part A of Atlantic Richfield Company, 2011). Figures 2, 3A and 3B show the engineering geologic mapping completed to date and the locations of previous investigations at the site through 2011. This previous subsurface investigation and reconnaissance mapping information was used, together with conceptual layouts and planning of potential future facilities, to develop the supplemental subsurface investigation and laboratory testing programs described in this Supplement to FSP.

4.2 Proposed Investigation Types and Locations

Figure 4 shows the location of primary existing and potential features to be characterized and the approximate location of borings and geotechnical monitoring wells. (Note that test pit locations will be determined in the field by AECOM's geotechnical engineer or engineering geologist). The investigation at each primary site or facility is described in Sections 4.2.1 through 4.2.9. This work is summarized on the Investigation Schedule included as Table 1. Drilling, sampling and sample handling methods are described in Sections 4.2.10 and 4.2.11, respectively. The latest edition of the Engineering Geology Field Manual (U.S. Bureau of Reclamation, 1998) will be used as a general guide for performing the subsurface investigations.

4.2.1 North Stacked Repository (NSR)

No further investigation at the NSR site is proposed based on verbal concurrence by EPA at a meeting on February 7, 2012 during which it was agreed that the existing active landslide at and immediately above this site, and the known and potential presence of remnant debris and foundations from the former acid plant at the site, together made this not a feasible location for a stacked solids repository or permanent solids drying facility.

4.2.2 Alternative North Drying Facility/Repository (ADF/R)

The objective of the investigation in this area is to characterize subgrade foundation settlement and stability of the ADF/R. To accomplish this objective, two (2) mud rotary RD borings (ADF/R-101 and ADF/R-102) will be drilled; one to 50 feet, and the other to 750 feet, in the former heap leach pad area and adjacent relatively flat ground at the northernmost end of the site.

The purpose of these borings is to evaluate depth, stratigraphy and SPT density of the existing fill and alluvial soils, relative to foundation support for a potential supplemental location for a permanent solids drying facility or repository.

4.2.3 Former Pond 19 Area

The objective of the investigation of the former Pond 19 area is to assess subgrade conditions in an area that may be excavated to enlarge the existing Pond 18 or serve as foundation for lime treatment plant facilities. This area is believed to have received calcines from the historic acid plant processing based on review of available aerial photography and the visible presence of calcines and mixed mine waste deposits at the surface. To accomplish these objectives, two (2) mud rotary RD borings (P19-101 and P19-102) will be drilled, one to 75 feet and the other to 50 feet, in the former Pond 19 area immediately north of the existing Pond 18.

The purpose of these borings is to evaluate depth, stratigraphy and SPT density of the existing fill and underlying alluvial soils, relative to potential enlargement of Pond 18 (including embankment construction if needed) and/or foundation support for lime addition plant facilities (silo, operations building, etc.).

4.2.4 South Stacked Repository (SSR)

The objective of the additional investigation of the SSR area is to establish the depth and approximate orientation of the contact between bedrock and the overlying talus/colluvium in the lower part of CHC Hill and adjacent fill/mine waste. This will help to characterize the subgrade foundation settlement and stability in the eastern portion of the SSR, and to evaluate potential borrow quantities for the overall project.

To accomplish this objective, four (4) borings (SSR-101 through SSR-104) will be drilled to bedrock through the existing overburden or talus/colluvium, plus 20 feet of coring by HQ-size triple-tube wireline method into the Hermosa bedrock (when encountered). SSR-101 and SSR-102 will be vertical borings completed using mud rotary drilling techniques (or possibly sonic drilling with heavy fluid as discussed previously). SSR-103 and SSR-104 will be completed from the base of the slope using the sonic drilling method, and at a sufficient down-angle below horizontal to penetrate the talus/colluvium plus 20 feet of core into relatively intact bedrock.

4.2.5 Pond 13 Area

The objective of this investigation is to evaluate the foundation support characteristics relative to use of the Pond 13 area for interim disposal of solids removed from Ponds 15, 14, 12, and 11, and possibly permanent disposal of solids currently in the interim drying facility and from future lime treatment (if adopted as a long-term treatment process)

This work will include evaluation of the depth of existing precipitated lime treatment solids and calcines, the density of these and the underlying alluvial deposits, and the location of the depth of the water table. Four (4) mud rotary RD borings are planned (P13-101 to P13-104). Two (2) borings will be drilled to bedrock plus 15 feet of coring by HQ-size triple-tube wireline method into the Hermosa bedrock (when encountered). The other two (2) borings will be drilled to 50 feet. Due to the anticipated soft condition of the existing solids at the surface, temporary earthen causeways will be constructed from the perimeter banks of the pond, to support the drilling equipment. A nominal 5-foot sampling interval is planned in denser strata, and a 2.5-foot sampling interval is planned in looser zones. Shelby tube samples will be attempted in the surface solids and calcines, and split spoon samples are planned in the embankment fills and alluvium. At completion, two (2) of the four (4) borings will be finished as geotechnical groundwater monitoring wells, with the screened intervals chosen based on the logging and sampling results.

4.2.6 Access/Entrance Road

The objective of this investigation is to evaluate subgrade conditions along the existing/proposed, primary access road into the site.

To accomplish this objective, five (5) mud rotary borings (AR-101 to AR-105) will be drilled to 15 feet or drilling refusal, whichever is shallower, along the proposed road alignment. SPTs will be performed and the split-spoon samples recovered at nominal 2.5-foot depth intervals.

The purpose of these borings is to evaluate stratigraphy, relative density and foundation support conditions along the alignment of what will be the main access road to the pond facilities.

4.2.7 Geotechnical Monitoring Wells (MW)

The primary objective of this investigation is to evaluate groundwater and seepage conditions relevant to geotechnical performance within such features as the flood dike, pond embankments and shallow alluvium, where existing data is sparse or inconclusive. This investigation will also provide additional information on the geotechnical conditions at these locations, since the borings will be sampled prior to well installation.

To accomplish these objectives, up to four (4) single or paired groundwater monitoring wells (MW-101 to MW-104) will be installed (co-located in new borings where possible). Candidate locations to co-locate the monitoring wells include SSR-101, SSR-102, ED-104 and ED-106. These locations may be revised as the data from other locations are collected.

The wells will be screened in the embankment fill or shallow, saturated strata commensurate with the data required (typical maximum depth is estimated at 25 feet). The results will be used to evaluate the need for pond flood dike and embankment and/or foundation upgrades and stabilization piping (internal erosion) protection, and the relative piezometric (groundwater) levels in the near-surface soils or fill and the underlying shallow alluvium for foundation design.

SSR-103 and SSR-104 will be completed with minimum 5-foot long, 2-inch nominal diameter PVC slotted well screens at intervals to be determined in the field if groundwater is encountered.

4.2.8 Flood Dike and Pond Embankments

The objective of the supplemental investigation of the existing flood dike and pond embankments is to further evaluate the need for pond flood dike and embankment and/or foundation upgrades and stabilization to address foundation and slope stability and seepage conditions, and piping potential.

As a screening tool to target areas for additional investigation, ground penetrating radar (GPR) will be tried as a means to identify the approximate vertical and/or lateral extent of especially loose or void zones (or other heterogeneities) within or beneath the pond embankments (approximate locations of the tests are shown on Figure 4).

Based on prior boring logs and using the results from the GPR profiling, up to six (6) RD borings will be drilled to 30 feet, at locations of previously identified voids or random fill zones within the embankments. Four of those locations are identified as follows:

- ED-101: Near the junction of the pond 14/15 embankment with the flood dike (prior Boring ED-5),
- ED-102: On the pond embankment between former Ponds 13 and 16 (prior Boring DH-3),
- ED-103: On the pond embankment at the southeast corner of former Pond 13 (prior Boring MW-4D),
- Near the west toe of the proposed South Stacked Repository (prior boring SSR-5 – to be covered as part of new boring SSR-102).

Other target locations may be identified from the GPR profiling or other subsurface investigation described herein.

The purpose of these borings is to evaluate the extent of already identified and suspected other voids, and the SPT density of previously identified random fill zones within the existing flood dike and pond embankment fill and alluvial foundation soils.

4.2.9 Loose Alluvium

The objective of this investigation is to identify the depth and location of loose alluvial foundations soils that may be subject to liquefaction during a design seismic event appropriate to the site. Up to six (6) borings to depths up to 80 to 100 feet are planned, at locations identified during previous investigations or geophysical work. A 5-foot sampling interval is planned in denser strata, and a 2.5-foot sampling interval is planned in looser zones. Where the deeper alluvium is found to be medium dense or denser, the respective boring may be terminated above the target depth listed.

Target zones not covered by additional borings already described above include:

- ED-104: Flood Dike west of Pond 7 (prior Boring ED-1),
- ED-105: Flood Dike west of Pond 8 (prior Boring DH-6),
- ED-106: Flood Dike west of Pond 9 (prior Boring DH-13),
- ED-107: Flood Dike west of Pond 15 (prior Boring MW-3D),
- ED-108: Pond Embankment between Ponds 9/10 and 11/13 (prior borings DH-4 and DH-5),
- ED-109: Pond Embankment between Ponds 14 and 15 (prior boring DH-2),

Looser deep alluvium identified in prior borings SSR-3, 4 and 5, and NSR-4 will be covered in other data gap borings to be completed in those areas.

4.2.10 Drilling and Sampling Methods

Typical sampling criteria for mud-rotary drilled (RD) borings are described as follows. Beginning at the surface, use a 2.5-foot sampling interval through fill zones (e.g., waste rock, calcines, random fill); use a 5-foot sampling interval through underlying alluvial, colluvial and/or landslide materials unless the SPT penetration resistance is N<20 blows per foot (bpf), in which case revert to a 2.5-foot sampling interval. Use a standard 2-inch-OD split-spoon sampler and SPT method per ASTM D 1586. Solid flight (SFA) or hollow-stem (HAS) augers may be used to advance the boreholes above the shallow groundwater table, whereupon mud rotary and rock coring drilling techniques will be used for the remainder of the respective boring. Given the uncertainty as to depth to bedrock at locations scheduled to penetrate bedrock, a minimum of 150 feet of drill pipe for RD and sonic drilling shall be available on site.

Sonic-drilled (SD) borings used for monitor well installation will be blank-drilled (without split-spoon or Shelby tube sampling of soil strata except as noted previously), using the recovered soft-cased soil core to obtain gradation and/or plasticity index test samples.

Note that sonic drill holes with heavy drilling fluid (bentonite or a synthetic admixture such as Revert) may be advanced adjacent to several borings currently planned to be drilled with conventional mud rotary methods to compare SPT N-values in a range of soils encountered. If the sonic method with drilling fluid proves to result in sufficiently comparable N-values (by countering the tendency for significant heave encountered when sonic drilling only with water during the 2011 investigation, and possible disturbance of in situ soils by the vibration imparted by the drill head), then the sonic method may be used in place of the mud rotary method where appropriate at various of the drilling locations described above. Where N-values are judged most critical it is intended that conventional mud rotary techniques be used.

AECOM or AECI engineering geologists or geotechnical engineers will keep a detailed log of each of the borings. The logs will include, but are not limited to, information on: drilling methods and equipment used; difficult or problematic drilling conditions (e.g., loss of drill fluid for RD drilling, refusal, etc.); depth of noticeable changes in material type; description of materials encountered (gradation, plasticity, density or consistency, color, moisture condition for soils); bedding, nature of contacts between units (sharp, gradational, etc.); structure or features of interest (roots, organics, fissures, voids, precipitates/salts, staining, etc.); depth interval, type and recovery of samples; SPT blow counts; and depth to groundwater if encountered. The inferred presence of coarse gravel, cobbles or boulders encountered in the borings will be noted on the logs to support proper interpretation of SPT blow counts.

If perched water is encountered above alluvial groundwater in RD borings (other than the monitoring wells described in Section 4.2.7 above) a decision will be made in the field as to installing a piezometer to permit monitoring that groundwater level over time. This decision will be based on the location of the boring, the depth to groundwater relative to the facility site being explored, and the presence of existing piezometers or monitoring wells that adequately monitor that higher groundwater condition.

Where bedrock is encountered, borings will be extended a minimum of ten to twenty (10 to 20) feet into rock as noted previously to confirm presence, lithology, jointing/fracturing, and weathering of the rock, utilizing coring techniques as determined by AECOM in consultation with AECI. The crew will note gain or loss of coring fluid, if encountered. Recovered core will be logged and photographed. Rock cores will be marked in the field for top versus bottom of the core run, and stored in purpose-made cardboard or wooden core boxes.

Boreholes that are not to be completed as monitoring wells or otherwise completed with a piezometer will be abandoned upon completion using a fluid cement/bentonite grout in conformance with any applicable state regulations.

4.2.11 Handling and Custody of Samples

Disturbed samples from SPTs and from sonic cased samples will be placed in labeled zip-lock bags to preserve gradation and moisture content for laboratory testing, and stored in labeled and sealed 5-gallon plastic buckets for transport to the laboratory. Thin-wall tube (i.e., Shelby tube) samples of cohesive soils or calcines will be labeled, capped and taped in the field. If the tube samples will be held for more than 24 hours prior to testing or storage in a controlled humidity room, the caps will be sealed in microcrystalline wax. Rock cores will be labeled by run with depth and top of core, and stored in wooden, corrugated plastic or waxed cardboard core boxes for delivery to the testing laboratory. Bulk samples from test pits will be stored in labeled, sealed five-gallon buckets. The remaining plastic-wrapped soil core from the sonic-drilled borings will be marked with boring number and top direction, and stored until the end of the 2012 investigations in the on-site metal building or another suitable location safe from vandalism.

A dedicated, full-time field sample technician will be utilized during the majority of the subsurface investigations. The sample technician's duties will include gathering the soil and rock samples from the logger at the back of the drill rigs, organizing and bulk packing the samples, filling out laboratory chain-of-custody forms (with copies transmitted to AECOM and AECI), and seeing that the samples are picked up or sent a minimum of twice per week for delivery to the respective testing laboratories. The laboratory tests will be chosen by the AECOM geotechnical engineer as designated by the Certifying/Design Engineer after review of the field boring logs, and transmitted separately to the laboratory(ies).

5.0 Geotechnical Investigation – Geophysical Profiling Program

One line each of Refraction Microtremor (ReMi) profiles will be completed to correlate the interpreted shear wave velocity with the depth to bedrock and evaluate looser zones of alluvium for potential liquefaction during an appropriate design seismic event selected for the site.

The ReMi technique measures shear wave velocities of subsurface materials in a vertical profile with depth beneath a line of surface geophones. Vibrations resulting from moving vehicles and other ambient or induced sources are employed to evaluate variations in subsurface strata. Data are recorded typically in 20 second sample intervals, with a two (2) millisecond sampling rate per channel. A key feature of the ReMi test is that the results are not adversely affected by the grain size of the soils.

By analyzing segments of the geophysical line and integrating the results, two-dimensional profiles are developed along the seismic line arrays. The results are presented on individual profiles that indicate variations in shear wave velocities along and below the ground surface along the length of the array by means of various colors or patterns.

6.0 Geotechnical Investigation – Test Pit and Sampling Program

It is anticipated that a limited number of test pits may be required to supplement the information collected from the drilling and geophysical profiling programs described above. The primary objectives of the test pits would be to: 1) observe and sample the full range of gradation, structure and consistency (density) of existing fill, native soils and proposed borrow sources, especially those characterized by coarse gravel, cobbles and/or boulders; 2) perform in situ density tests of suitable gradation soils; and 3) investigate shallow occurrences of voids or especially loose soils (if this can be done safely and without threatening the existing integrity of the feature or area to be investigated).

To accomplish this objective, up to 12 test pits will be excavated using a track-mounted excavator with at least a 20- to 25-foot reach. Proposed locations for test pits are not shown on the attached field investigations map as the locations will be selected by AECOM's geotechnical engineer or engineering geologist with input from AECI based on the soil boring and geophysical profiling results. Safety and accessibility criteria will be fully met in locating, planning and implementing any test pit investigations. Potential target areas for test pits include pond embankments, potential on-site borrow areas, and discrete fill materials (e.g., calcines in the former Pond 13 area, or waste rock). Special caution will be implemented if excavating test pits in existing embankment fill. Bulk samples will be collected for laboratory testing as described in Section 7.0.

The engineering geologist or geotechnical engineer will maintain a log of the test pit conditions, including approximate plan dimensions, total depth, depths of strata change, detailed description of materials encountered (including color, approximate gradation, plasticity, etc.), and indication (e.g., mottling or staining) plus depth to groundwater or bank/slope seepage. Photographs will be taken to document sidewall stability, groundwater seepage/accumulation, and material variations/stratigraphy.

At completion, each test pit will be backfilled with the material excavated from the pit or other suitable backfill as determined by AECOM or AECI using bucket and track tamping for compaction. Recovered bulk samples will be handled by the sample clerk as described in Section 4.2.11.

7.0 Geotechnical Laboratory Testing Program

7.1 Testing Program

The following typical laboratory testing program is planned, with variations to be determined based on number, length and type of samples recovered:

> ***Moisture Content***: all recovered samples except clean gravels and rockfill (GP, GW); used for soil classification.
>
> ***Atterberg Limits***: representative clayey silt or clay samples (up to 24); used for soil classification.
>
> ***Hand Penetrometer or Torvane***: all tube samples of cohesive soils (clays or clayey silts); used for soil classification and to estimate unconfined compressive strength.

Unconfined Compression/Dry Unit Weight: representative cohesive samples (up to 14); used to estimate unconfined compressive strength, undrained shear strength, and unit weight for slope stability and foundation/subgrade analyses.

Grain Size Analysis: representative coarse-grained (i.e., predominantly sand and gravel) samples, including miscellaneous fill/mine waste/demolition debris, sidehill colluvium and landslide debris, calcines, and borrow sources (up to 30); with determination of percent passing USCS No. 200 sieve (P200) as appropriate. The results will be used for evaluation of foundation/subgrade stability, seepage analyses through the flood dike, embankment and pond bottoms, and evaluation of borrow sources to provide structural embankment fill and possibly filter and/or drain material.

Direct Shear: representative re-compacted sidehill colluvium, dike fill and calcines samples (up to 6 samples of the minus 1-inch fraction). Density of re-compacted samples is to be based on field nuclear density and/or SPT results. The results are to be used for foundation bearing capacity and slope stability analyses.

Triaxial Shear: representative compacted samples of the minus 1-inch fraction of colluvium, landslide debris (not failure plane material), dike fill and calcines samples (up to 6). The results are to be used for foundation bearing capacity and slope stability analyses.

Moisture/Density (Proctor) Testing: representative on-site colluvium, landslide debris, fill, waste rock, and possibly selected off-site borrow sources (up to 4). These test results are to be used to establish density and moisture content criteria for engineered fill placement.

Rock Core Testing: (to be determined) if intact rock core of sufficient quality is recovered during the field investigations program; may include unit weight, unconfined compression, direct shear, and/or tensile splitting testing depending on the characteristics of the core recovered.

7.2 Quality Assurance/Quality Control of Laboratory Testing

AECOM will approve the selected geotechnical laboratories prior to employing the laboratories and prior to commencement of testing activities. The role of the testing laboratory is to provide testing of soil (and possibly rock core) samples recovered from the borings and test pits completed as part of this Supplement to FSP. Laboratory tests will be completed per associated ASTM Standards or other industry recognized standards as agreed to by AECOM.

8.0 References

Atlantic Richfield Company. 2011. 2011 Investigations, Analyses and Evaluations (Part A – Engineering Geologic and Geotechnical Field Investigations and Laboratory Testing). Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado; submitted to US EPA, Region 8, Denver, CO. December.

U.S. Department of the Interior, Bureau of Reclamation. 1998. Engineering Geology Field Manual, Second Edition, Volume I (1998, reprinted 2001) and Volume II (2001). http://www.usbr.gov/pmts/geology/geoman.html

U.S. Environmental Protection Agency (EPA). 2011. Removal Action Work Plan, Rico-Argentine Mine Site – Rico Tunnels Operable Unit OU01, Rico, Colorado. March 9.

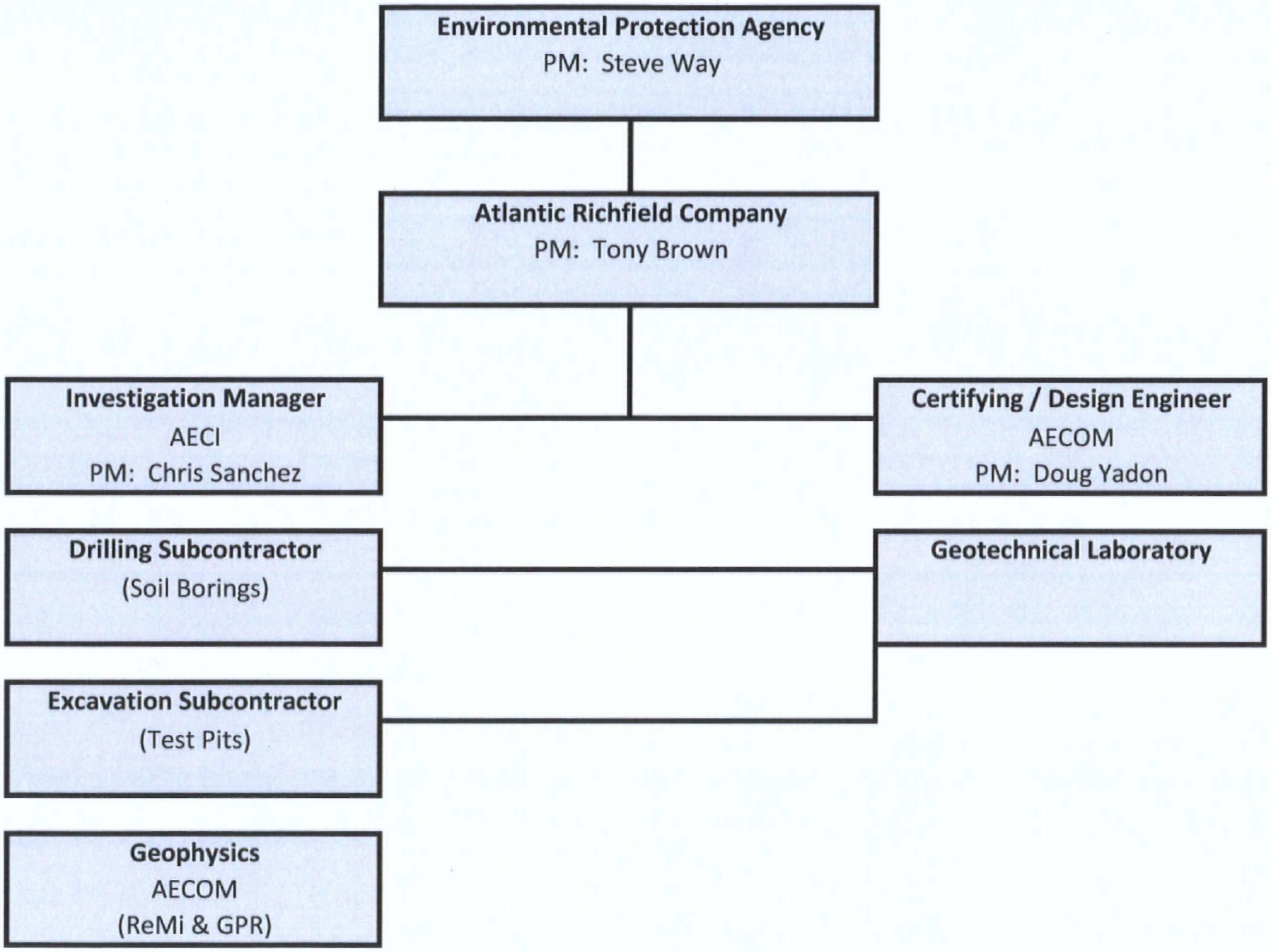
TABLES

Table 1. 2012 Field Investigation Schedule

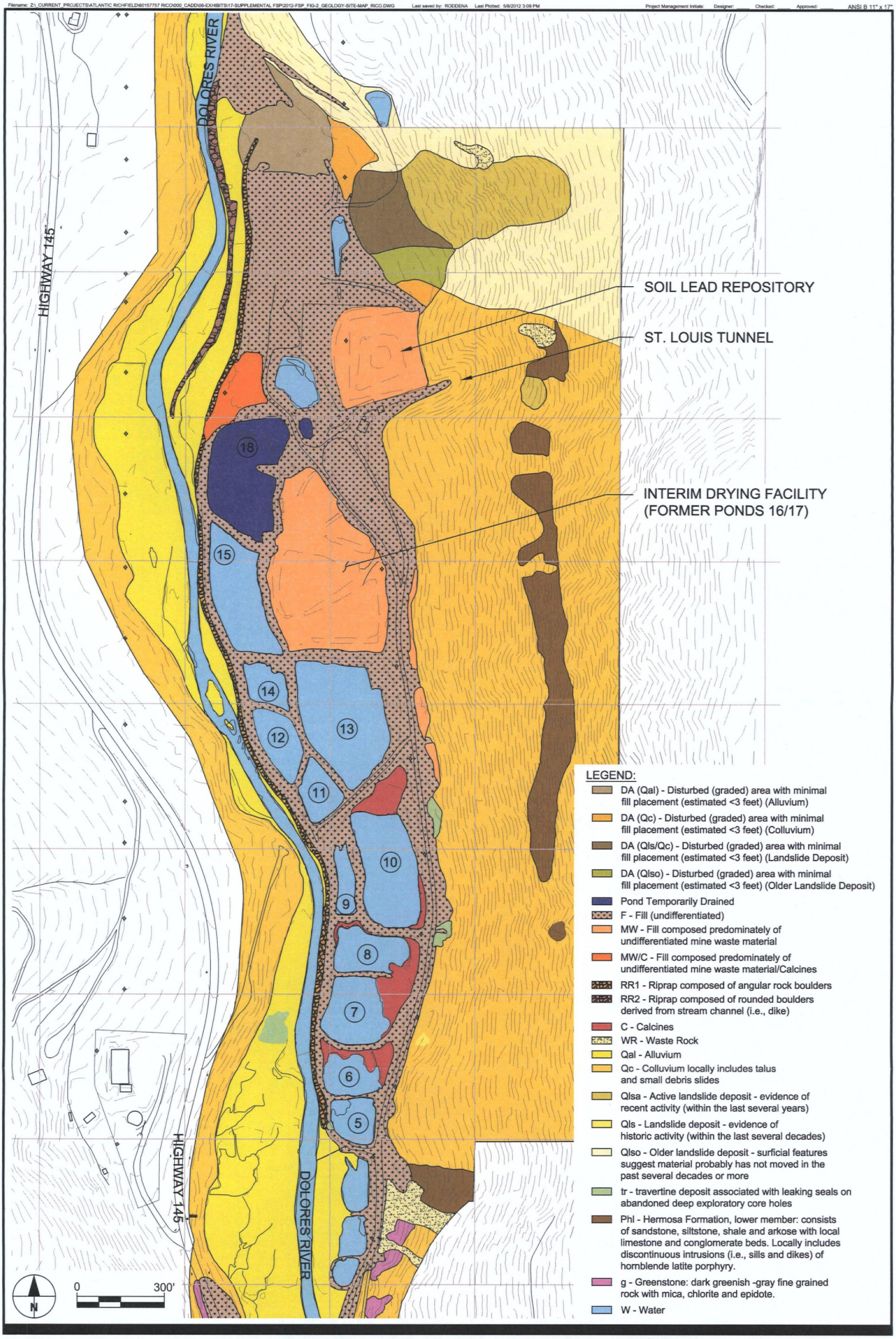
Investigation No.	General Location	Depth (Estimated)	Rig Type	Monitoring Well	Notes
ADF/R-101	Alt. Drying Facility	50 ft	Mud Rotary	No	
ADF/R-102	Alt. Drying Facility	75 ft	Mud Rotary	No	
P19-101	Former Pond 19	50 ft	Mud Rotary	No	
P19-102	Former Pond 19	75 ft	Mud Rotary	No	
SSR-101	South Stacked Repository-West	To bedrock plus 20 ft bedrock core	Mud Rotary	Possible	Vertical boring
SSR-102	South Stacked Repository-West	To bedrock plus 20 ft bedrock core	Mud Rotary	Possible	Vertical boring
SSR-103	South Stacked Repository-East	To bedrock plus 20 ft bedrock core	Sonic	Possible	Inclined boring to investigate colluvium/bedrock contact location and orientation
SSR-104	South Stacked Repository-East	To bedrock plus 20 ft bedrock core	Sonic	Possible	Inclined boring to investigate colluvium/bedrock contact location and orientation
P13-101	Pond 13	To bedrock plus 15 ft bedrock core	Mud Rotary	No	Temporary causeways required for access over soft surface
P13-102	Pond 13	To bedrock plus 20 ft bedrock core	Mud Rotary	No	Temporary causeways required for access over soft surface
P13-103	Pond 13	50 ft	Mud Rotary	No	Temporary causeways required for access over soft surface
P13-104	Pond 13	50 ft	Mud Rotary	No	Temporary causeways required for access over soft surface
AR-101	Primary Access Road	15 feet or drilling refusal	Mud Rotary	No	
AR-102	Primary Access Road	15 feet or drilling refusal	Mud Rotary	No	
AR-103	Primary Access Road	15 feet or drilling refusal	Mud Rotary	No	
AR-104	Primary Access Road	15 feet or drilling refusal	Mud Rotary	No	
AR-105	Primary Access Road	15 feet or drilling refusal	Mud Rotary	No	
MW-101	Co-locate with SSR-101	Fill thickness + 10 ft into alluvium	Mud Rotary	Yes	Position and/or depth may be revised based on investigation results
MW-102	Co-locate with SSR-102	Fill thickness + 10 ft into alluvium	Mud Rotary	Yes	Position and/or depth may be revised based on investigation results
MW-103	Co-locate with ED-106	Embankment height + 10 ft into alluvium	Mud Rotary	Yes	Position and/or depth may be revised based on investigation results
MW-104	Co-locate with ED-104	Embankment height + 10 ft into alluvium	Mud Rotary	Yes	Position and/or depth may be revised based on investigation results
ED-101	Prior Boring ED-5	30 ft	Mud Rotary	No	Previously identified void or random fill zone in embankment
ED-102	Prior Boring DH-3	30 ft	Mud Rotary	No	Previously identified void or random fill zone in embankment
ED-103	Prior Boring MW-4D	30 feet	Mud Rotary	No	Previously identified void or random fill zone in embankment
ED-104	Prior Boring ED-1	80 t 100 ft	Mud Rotary	Possible	Previously identified loose alluvium
ED-105	Prior Boring DH-6	80 to 100 ft	Mud Rotary	Possible	Previously identified loose alluvium
ED-106	Prior Boring DH-13	80 to 100 ft	Mud Rotary	No	Previously identified loose alluvium
ED-107	Prior Boring MW-3D	80 to 100 ft	Mud Rotary	No	Previously identified loose alluvium
ED-108	Prior Boring DH-4	80 to 100 ft	Mud Rotary	No	Previously identified loose alluvium
ED-109	Prior Boring DH-2	80 to 100 ft	Mud Rotary	No	Previously identified loose alluvium
RM-101	ADF/R-102	Determined by profile length/materials	N/A	N/A	Refraction-Microtremor line in east-west direction near ADF/R-102 (by AECOM)
RM-102	Valley bottom west of Pond 15	Determined by profile length/materials	N/A	N/A	Refraction-Microtremor line in east-west direction west of Pond 15 (by AECOM)
RM-103	Valley bottom immediately u/s of SH 145 bridge	Determined by profile length/materials	N/A	N/A	Refraction-Microtremor line in east-west direction upstream of highway bridge (by AECOM)
GPR	All Pond Embankments	Determined by subsurface conditions	N/A	N/A	Ground Penetrating Radar on existing pond embankments (by AECOM)

FIGURES

Figure 1 - Field Sampling Plan Organization



Filename: Z:_CURRENT_PROJECTS\ATLANTIC RICHFIELD\60157757 RICO\000_CADD\06-EXHIBITS\17-SUPPLEMENTAL FSP\2012-FSP_FIG-2_GEOLOGY-SITE-MAP_RICO.DWG Last saved by: RODDENA Last Plotted: 5/8/2012 3:09 PM Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI B 11" x 17"



RICO-ARGENTINE SITE-OU01

2012 SUPPLEMENT TO FIELD SAMPLING PLAN

FIGURE 2 - PRELIMINARY ENGINEERING GEOLOGIC MAP

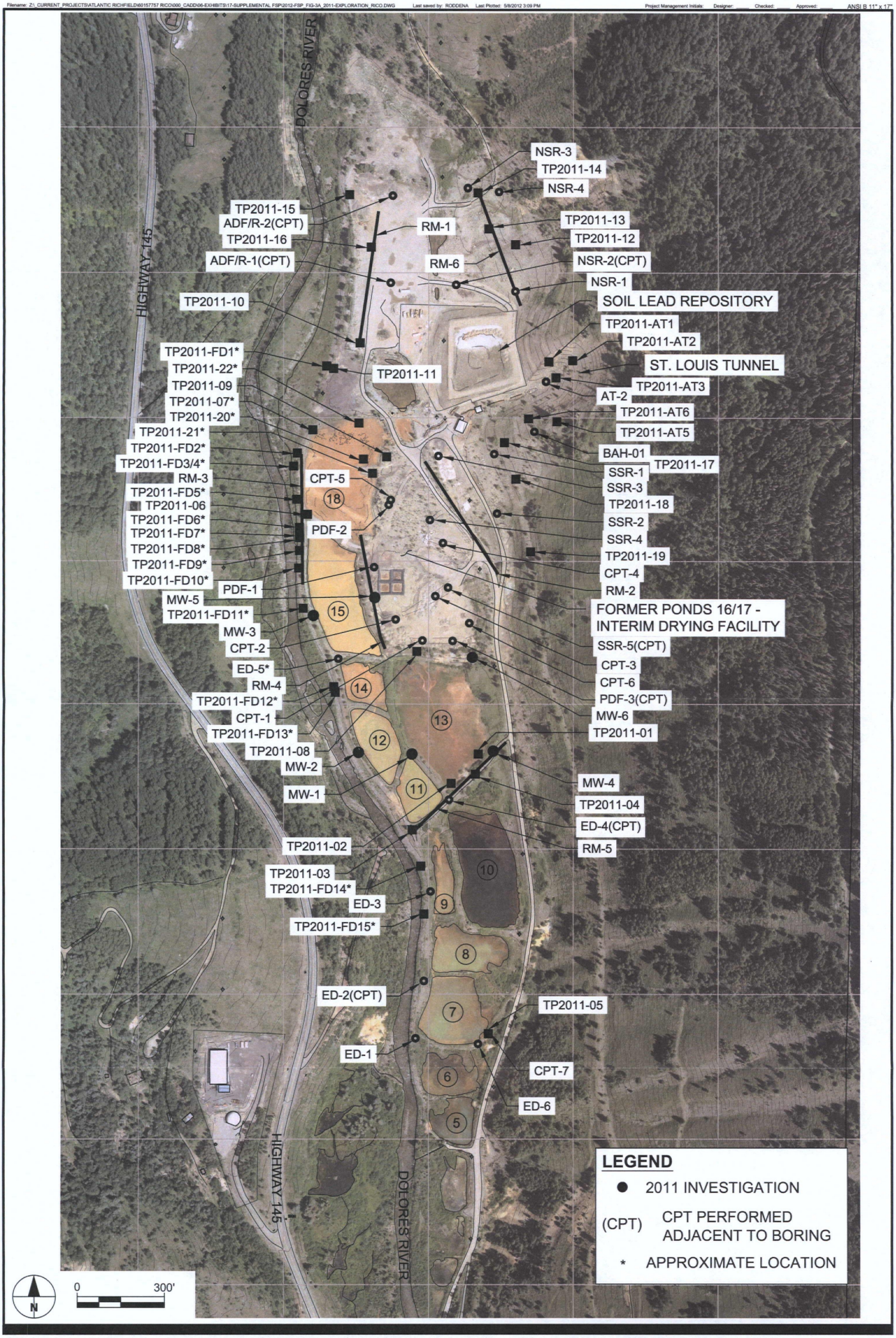
PRELIMINARY

AECOM

MAY 8, 2012

60239806

Filename: Z:_CURRENT_PROJECTS\ATLANTIC RICHFIELD\60157757 RICO\000_CADD\06-EXHIBITS\17-SUPPLEMENTAL FSP\2012-FSP_FIG-3A_2011-EXPLORATION_RICO.DWG Last saved by: RODDENA Last Plotted: 5/8/2012 3:09 PM Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI B 11" x 17"



PRELIMINARY

RICO-ARGENTINE SITE-OU01

2012 SUPPLEMENT TO FIELD SAMPLING PLAN

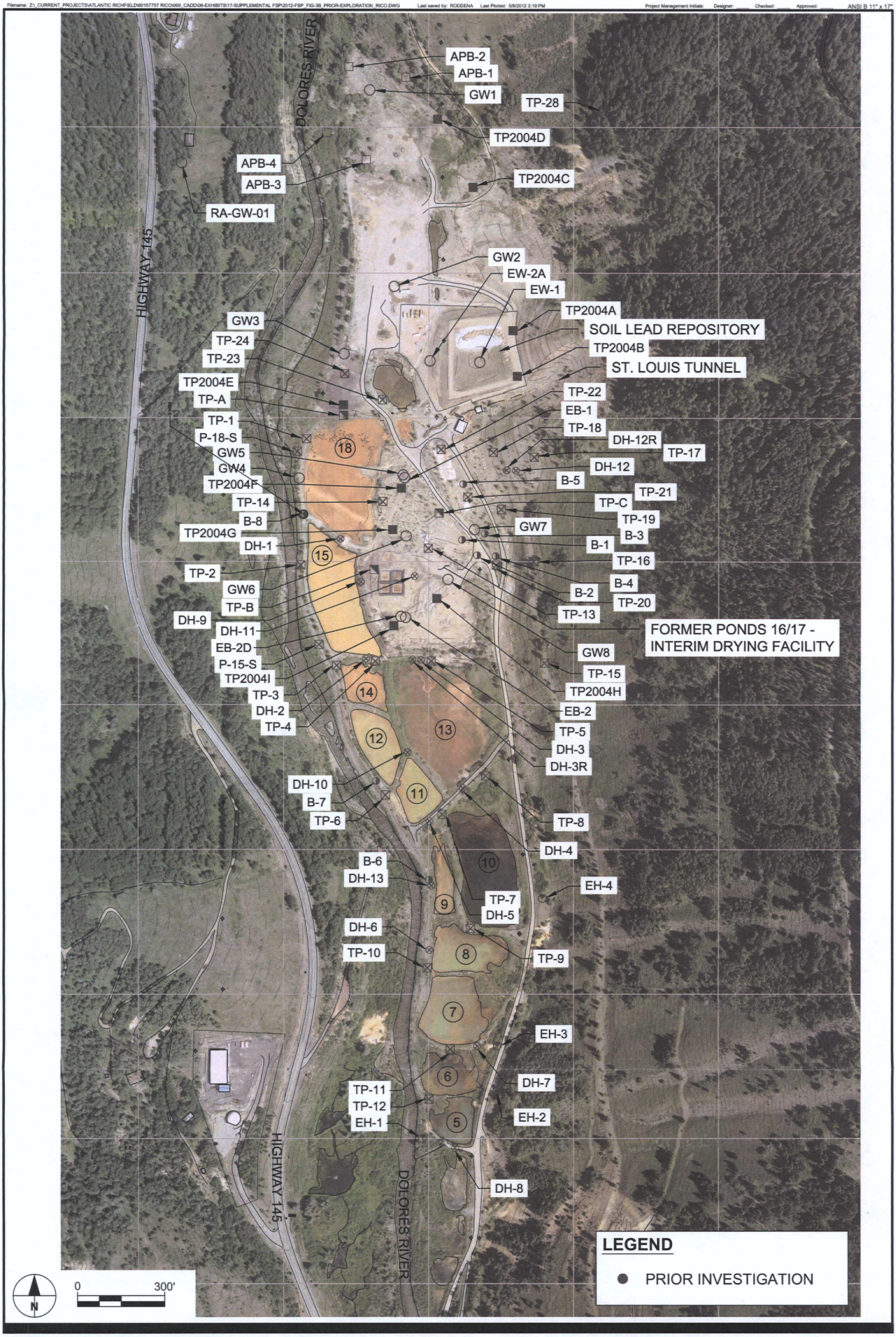
FIGURE 3A - SUMMARY OF 2011 FIELD INVESTIGATIONS

AECOM

MAY 8, 2012

60239806

Filename: Z:_CURRENT_PROJECTS\ATLANTIC RICHFIELD\60157757 RICO\000_CADD\06-EXHIBITS\17-SUPPLEMENTAL FSP\2012-FSP_FIG-3B_PRIOR-EXPLORATION_RICO.DWG Last saved by: RODDENA Last Plotted: 5/8/2012 3:19 PM Project Management Initials: Designer: ____ Checked: ____ Approved: ____ ANSI B 11" x 17"



RICO-ARGENTINE SITE-OU01

2012 SUPPLEMENT TO FIELD SAMPLING PLAN

FIGURE 3B - SUMMARY OF PRIOR FIELD INVESTIGATIONS

PRELIMINARY

AECOM

MAY 8, 2012

60239806

RICO-ARGENTINE SITE-OU01

2012 SUPPLEMENT TO FIELD SAMPLING PLAN

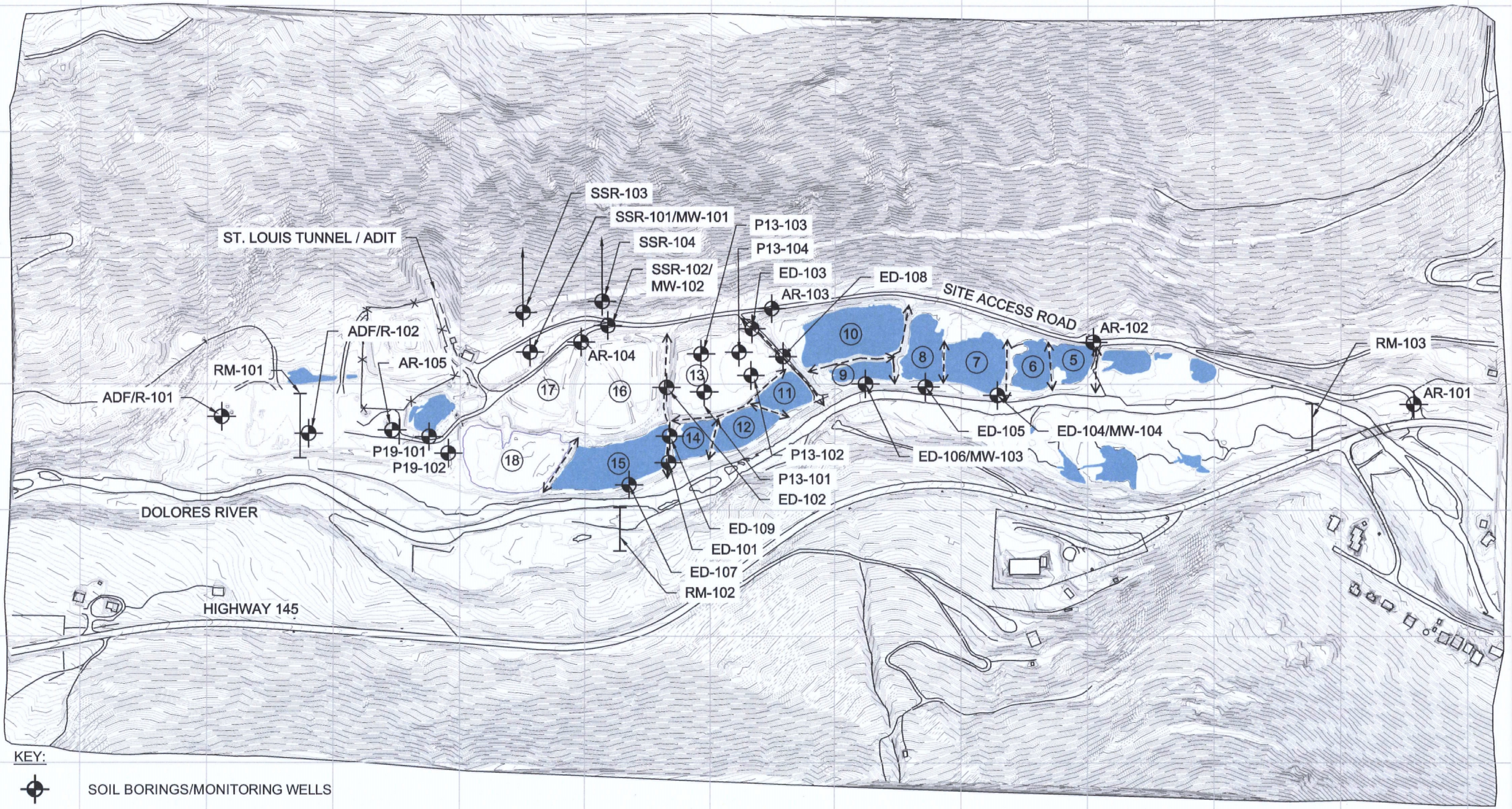
FIGURE 4 - PROPOSED 2012 FIELD INVESTIGATIONS

AECOM

JUNE 8, 2012

60239806

PRELIMINARY



KEY:

SOIL BORINGS/MONITORING WELLS

INCLINED BORING

REFRACTION MICROTREMOR GEOPHYSICAL PROFILES

GROUND PENETRATING RADAR PROFILES

(15) POND NUMBER

EXPLORATION LAYOUT

0 400' 800'

N